

VERDIGRIS BASIN TOTAL MAXIMUM DAILY LOAD

Water Body: Verdigris River

Water Quality Impairment: Biological Impairment*

1. INTRODUCTION AND PROBLEM IDENTIFICATION

Subbasin:	Middle Verdigris
Counties:	Montgomery, Labette, Neosho, and Wilson
HUC 8:	11070103
HUC 11 (HUC 14s):	010 (030, 040, 050, 060, 070, 080, & 090) 020 (040, 050, 060, & 070)
Drainage Area:	457 square miles
Main Stem Segment:	WQLS: 27, 29, 33, & 35; starting at the Oklahoma border, traveling upstream, and ending above the confluence with Rock Creek near the City of Independence.
Designated Uses:	Special Aquatic Life Support, Primary & Secondary Contact Recreation; Domestic Water Supply; Food Procurement; Ground Water Recharge; Industrial Water Supply Use; Irrigation Use; Livestock Watering Use on Main Stem Segments.
1998 303(d) Listing:	Table 2—Stream Segments Identified by Biological Monitoring
Impaired Use:	Special Aquatic Life Support on Main Stem Segments.
Water Quality Standard:	General--Narrative: Surface water shall be free, at all times, from the harmful effects of substances that originate from artificial sources of pollution and that produce any public hazard, nuisance condition or impairment of a designated use. (KAR 28-16-28e(b)(1)). Ammonia—Table 1d of KAR 28-16-28e; chronic aquatic life criteria for total ammonia with early life stages of fish present, varying by pH and temperature.

** The 1998 303d list identified this segment as impaired by nutrients and oxygen demand as indicated by biological monitoring, using MBI scores. The actual impairing pollutant was unknown at the time of listing and in this phase of the TMDL is presumed to be ammonia until further data and information indicate otherwise. Thus, this TMDL will be indicated as Biological Impairment.*

2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Level of Support for Designated Use under 1998 303(d):

Partially Supporting on Segment 27

Fully Supported but Threatened on Segments 29, 33, and 35

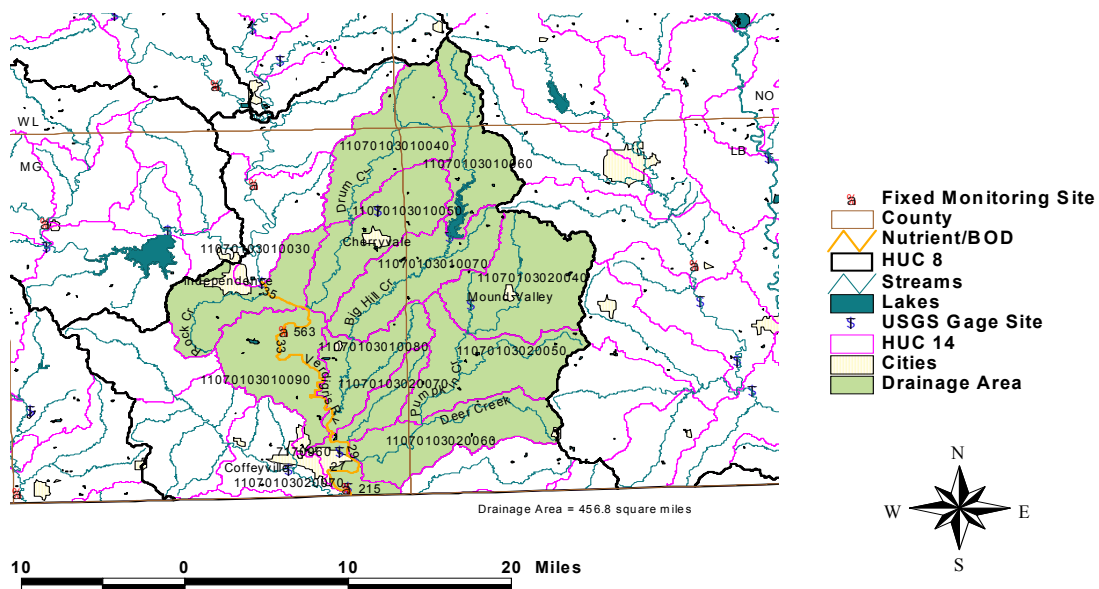
Monitoring Sites: Station 215 near Coffeyville and station 563 near Independence (Figure 1)

Period of Record Used: Stream Chemistry: Station 215 (1985 - 2001)

Station 563 (1990 - 2001)

Biological Monitoring: Station 215 (1980 - 2001)

Verdigris River TMDL Reference Map



Station 563 (1995 - 1999)

Figure 1

Flow Record: Verdigris River at Lenapah (USGS Station 07171000); 1971 to 2000.

Current Conditions:

Three main parameters (MBI, %EPT, and BOD) were analyzed to address the nutrient/oxygen demand impairment. The Macroinvertebrate Biotic Index rates the nutrient and oxygen

demanding pollution tolerance of large taxonomic groups (order and family). Higher values indicate greater pollution tolerances. Along with the number of individuals within a rated group, a single index value is computed which characterizes the overall tolerance of the community. The higher the index values the more tolerant the community is of organic pollution exerting oxygen demands in the stream setting. Index values greater than 5.4 are indicative of non-support of the aquatic life use; values between 4.51 and 5.39 are indicative of partial support and values at or below 4.5 indicate full support of the aquatic life use.

The EPT index is the proportion of aquatic taxa present within a stream belonging to pollution intolerant orders; Ephemeroptera, Plecoptera and Trichoptera (mayflies, stoneflies and caddisflies). Higher percentages of total taxa comprising these three groups indicate less pollutant stress and better water quality.

For station 215, the greater impaired of the two stations, the average MBI value of 4.40 (range: 3.28-5.34) indicates that aquatic life support is fully supported but threatened (MBI less than 4.51). As seen in Appendix A, forty-five percent of the surveys resulted in MBI values over 4.5; the rest were under 4.5, indicative of full support of aquatic life. Average MBI under partial support conditions was 4.69; average MBI under full support conditions was 4.15. When aquatic life is partially impaired, the percentage of EPT taxa ranges from 19.0 - 56.0% (39.5% average). Under full support conditions, the percentage averages 57.6%. Additionally, there were five annual samples taken at Station 563 below Independence during 1995-1999. One of the five (in 1996) samples was indicative of some biological impairment.

Ambient stream chemistry data bracketing the time each of the biological samples were collected was analyzed as to differences between impaired and full support conditions. These data indicate that for station 215, increases in chloride and ammonia and a decrease in total suspended solids during the periods of impairment are significant. Other than these parameters, ambient stream conditions are not significantly different between full support or impaired indications. Another factor which seems to correlate with diminished aquatic life support is low flow condition. Lower flow conditions may also be responsible for the higher chloride and ammonia levels seen during impaired situations. Conversely, higher flows carrying more sediment may explain the inverse relationship between MBI and TSS, i.e., the biota may benefit more from the adequate streamflow than they are hampered by the elevated TSS levels occurring at the same time. Plotting MBI against the percent flow exceedance during biological sampling reveals full support conditions tend to occur around 50-75% flow, while the conditions of partial support are more prevalent under lower flow conditions exceeded 75% of the time or more. There is a significant difference in the flows occurring during impaired and attained conditions. The average concentration of ammonia from samples taken below median flow is 0.14 mg/l. Compared to average and fitted loadings determined from the data, there are a number of higher ambient loads occurring during the lower flows (Figure 2).

Biological index values and average concentrations of typical wastewater pollutants were compared for the biological monitoring stations located in the Verdigris Basin. Overall, the average concentrations of ammonia at site 215: the Verdigris River at Coffeyville sampling site

tended to be higher than the three upstream sampling stations (sites 563,105 & 277)

Average Concentrations under Different Aquatic Life Support Conditions at Station 215

MBI	EPT	NH ₃	TSS	BOD	NO ₃	TP	pH	Temp	Cl	DO	TDS
Fully Supporting ALS (MBI ≤ 4.5)	57.6%	0.04 mg/l	228 mg/l	3.4 mg/l	0.55 mg/l	0.26 mg/l	7.9	22.2 °C	23mg/l	8.0 mg/l	238 mg/l
Partially Supporting ALS (MBI > 4.5)	39.5%	0.13 mg/l	33 mg/l	4.2 mg/l	0.57 mg/l	0.19 mg/l	8.0	23.0 °C	30mg/l	8.8 mg/l	263 mg/l

Comparison of Biological Index Values and Average Pollutant Concentrations

Station	MBI	Ammonia	BOD	TSS
SB215 Verdigris River near Coffeyville	4.4	0.08 mg/L	3.3 mg/L	94 mg/L
SB563 Verdigris River at Independence	4.3	0.06 mg/L	3.2 mg/L	82 mg/L
SB105 Verdigris River near Sycamore	4.3	0.04 mg/L	3.0 mg/L	89 mg/L
SB277 Fall River near Neodesha (SC562)	4.1	0.05 mg/L	2.9 mg/L	69 mg/L

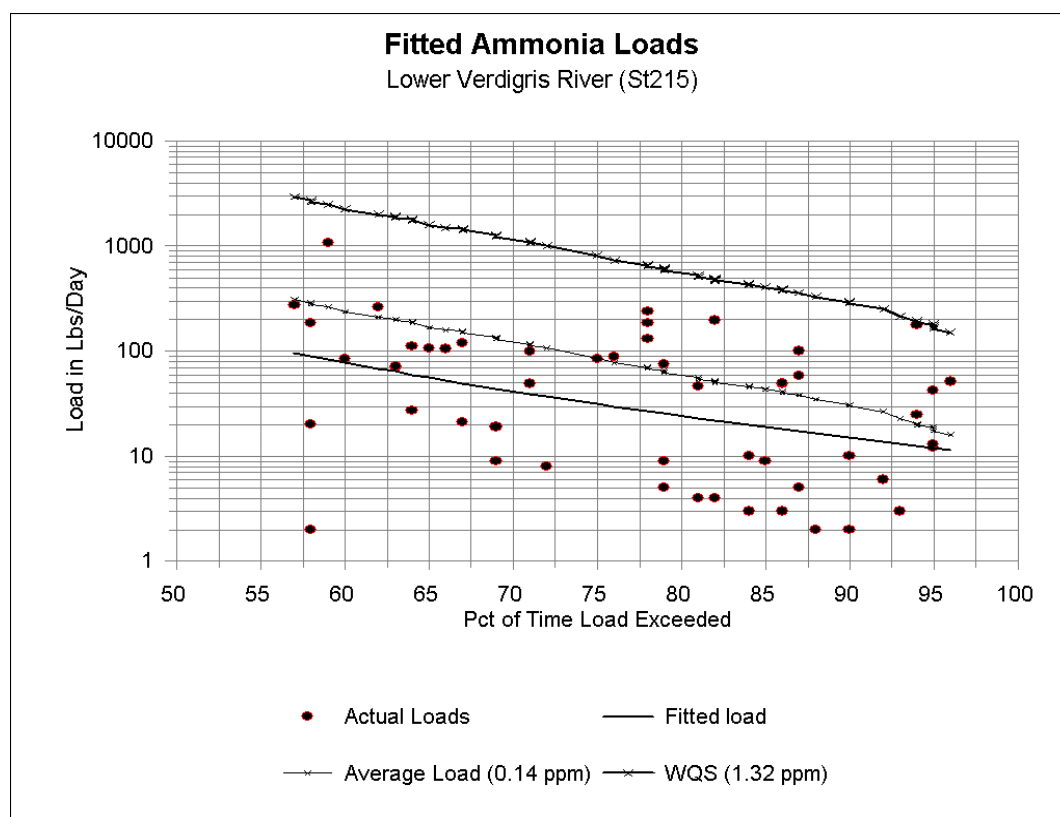


Figure 2

Desired Endpoints of Water Quality at Sites 215 and 563 over 2007 - 2011:

The use of biological indices allows assessment of the cumulative impacts of dynamic water quality on aquatic communities present within the stream. As such, these index values serve as a baseline of biological health of the stream. Sampling occurs during open water seasons (April to November) within the aquatic stage of the life cycle of the macroinvertebrates. As such there is no described seasonal variation of the desired endpoint of this TMDL. The endpoint would be no more than 1 sampling with a MBI values greater than 4.5 over 2007-2011.

Achievement of this endpoint would be indicative of full support of the aquatic life use in the stream reach. While there is some linkage between MBI values and flow conditions, there is also some evidence implicating ammonia, although there have been no violations of chronic water quality criteria. Therefore, this TMDL will be phased, concentrating on lowering ammonia levels below their average of 0.14 mg/l at flows below the median flow seen at the stateline. Some of this endpoint may already be occurring because of recent ammonia reduction projects at Coffeyville and Independence.

3. SOURCE INVENTORY AND ASSESSMENT

NPDES: There are seven NPDES wastewater dischargers that have effluent limitations for biochemical oxygen demand, total suspended solids, and ammonia (Figure 3). Two facilities, Elk City State Park Wastewater Facility and Park West Properties Wastewater Treatment Facility, are non-overflowing lagoons that are prohibited from discharging and would only contribute an ammonia load under extreme precipitation events (flow durations exceeded up to 5 percent of the time). Such events do not coincide with the conditions of biological impairment seen at Monitoring Site 215.

Three facilities utilize discharging lagoons for their wastewater. All three facilities are designed to KDHE minimum design standards. Mound Valley has recorded ammonia levels of 2.68 and 3.77 mg/l in June 2002 and October 2001, respectively. Liberty has rarely discharged in the past 30 months. There are no data from Edna, however, a study of lagoon performance in reducing pollutant levels indicates that lagoons which meet minimum design standards discharged an average of 0.27 - 2.7 mg/l of ammonia. Maximum amounts of ammonia sampled ranged from 0.59 - 5.77 mg/l. Samples taken in May and September, coinciding with periods of high biological activity were within these ranges, measuring between below detection limits and 5 mg/l of ammonia.

The remaining four facilities are activated sludge treatment systems which have permit limits in place for ammonia in accord with Kansas Surface Water Quality Standards. The three cities have seasonal limits which peak in the winter and are minimized in July and August. Farmland, a refinery operation, has a constant 2.4 mg/l limit year round. The mechanical plants at Coffeyville and Independence have recently completed upgrades to their treatment capabilities. Cherryvale is replacing its facility with a lagoon system which would allow it to comply with the final permit limits by the end of 2005.

Examination of the discharge monitoring reports for the facilities indicate few problems in

violating permit limits (Appendix B). Typically, problems have arisen during winter months. Cherryvale appears to have the greatest difficulty in complying with its ammonia limits, in part necessitating the replacement of the existing facility.

The watershed is expecting an overall population decline. State projections of population for all six of the cities indicate declines over the next 20 years from current population levels. Projections of future water use and resulting wastewater appear to remain within design flows for each of the current system's treatment capacity.

Discharging NPDES and Non-overflowing Sites

MUNICIPAL FACILITY	STREAM REACH	EXPIRATION DATE	DESIGN FLOW	TYPE
FARMLAND INDUSTRIES - COFFEYVILLE REFINERY	VERDIGRIS RIVER	12/31/04	2.66 MGD	Refinery WWTF
CHERRYVALE WWTP	VERDIGRIS R VIA DRUM CREEK VIA UNNAMED TRIBUTARY	9/30/06	0.4 MGD	Activated Sludge; Two Cell Extraneous Flow Lagoon (New Lagoon System in Construction)
COFFEYVILLE WWTP	VERDIGRIS RIVER	6/30/06	4.0 MGD	Activated Sludge
EDNA WWTP	DEER CREEK	3/31/06	0.0524 MGD	Three Cell Lagoon
MOUND VALLEY WWTP	VERDIGRIS RV VIA PUMPKIN CK VIA LOST BRANCH	3/31/06	0.03267 MGD	Two Cell Lagoon
INDEPENDENCE WWTP	VERDIGRIS RIVER	6/30/06	3.0 MGD	Activated Sludge
LIBERTY WWTP	BIG HILL CREEK VIA UNNAMED TRIBUTARY	12/31/06	0.018 MGD	Three Cell Lagoon
ELK CITY STATE PARK WF	N/A	3/31/07	Non-Overflowing	Two Cell Lagoon
PARK WEST PROPERTIES WTF	N/A	12/31/04	Non-Overflowing	Two Cell Lagoon

Livestock Waste Management Systems: Twenty-one operations are registered, certified, or permitted within the watershed (Figure 4). The facility type is either beef (2), swine (9), dairy (9), or poultry (1). All permitted livestock facilities have waste management systems designed to minimize runoff entering their operations or detaining runoff emanating from their areas. Such systems are designed to retain the 25 year, 24 hour rainfall/runoff event, as well as an anticipated two weeks of normal wastewater from their operations. Such a rainfall event typically coincides

with stream flows which are exceeded 1-5 percent of the time. Therefore, events of this type, infrequent and of short duration, are not likely to cause chronic impairment of the designated aquatic life uses of the waters in this watershed, since the impairments are seen at lower flows.. Requirements for maintaining the water level of the waste lagoons a certain distance below the lagoon berms ensure retention of the runoff from the intense, local storms events. In Montgomery County, where many of the facilities are relatively close to the river, such an event would generate 6.8 inches of rain, yielding 5.6 to 6.4 inches of runoff in a day. NPDES permits, also non-discharging, are issued for facilities with more than 1,000 animal units. None of the facilities in the watershed are of this size. Potential animal units for all active facilities in the watershed is 2,635 animal units. Eleven of the facilities are inactive and were once permitted for 4,253 animal units. The actual number of animal units on site is variable, but typically less than potential numbers.

Verdigris River NPDES Sites

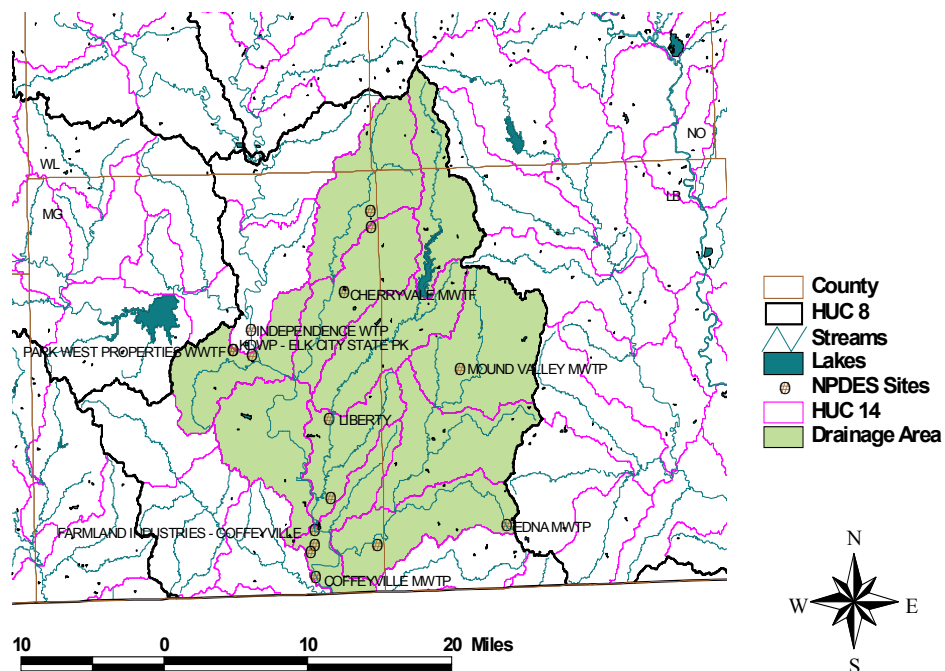


Figure 3

Verdigris River Livestock Waste Management Facilities

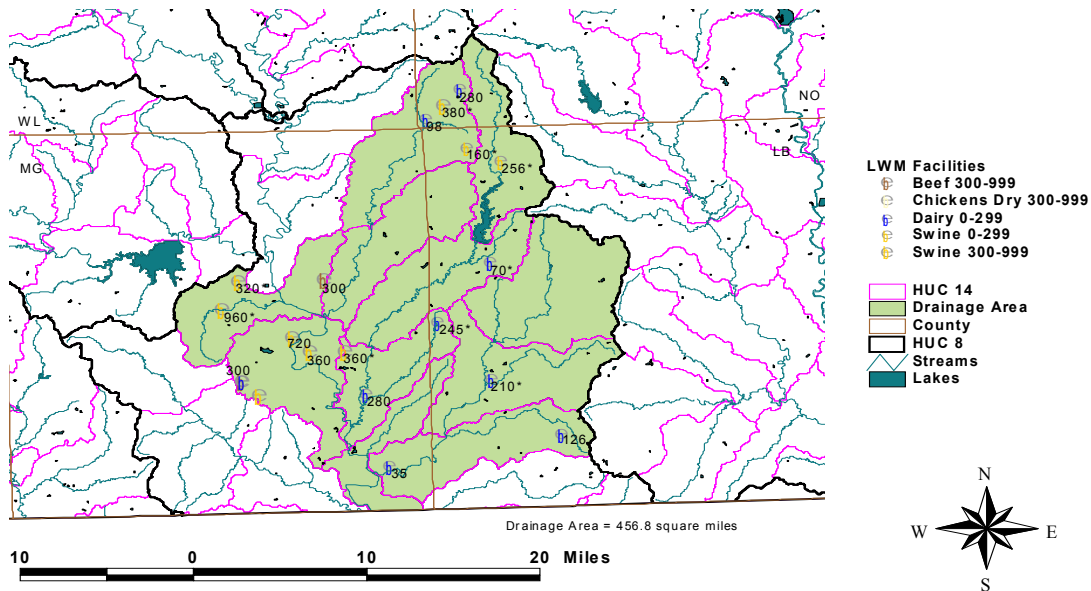


Figure 4

Land Use: Most of the watershed is grassland (58% of the area), cropland (34%), woodland (5%) or urban use (2%). (See Figure 5). The summer grazing density is high for the watershed whereas the winter grazing density is moderate.

On-site Waste Systems: Twenty-one percent of households in Montgomery County and 23% of households in Labette County in the watershed have septic systems. The population density is high for the watershed area (56.8 people/mi²). In spite of population loss in their towns, Montgomery and Labette Counties are expecting moderate growth over the next 20 years. Kansas Water Office projections estimate population growth in the unincorporated areas of the counties to grow 3.4% for Labette County and 9.9% for Montgomery County between 2000 and 2020. This population base will likely utilize on-site wastewater systems. However, the number of failing systems will likely diminish through efforts of the Local Environmental Protection Program and by their low volume nature, only such failing systems close to the streams will likely have an impact on ambient stream water quality.

Contributing Runoff: The watershed's average soil permeability is 0.8 inches/hour according to NRCS STATSGO data base. About 100% of the watershed produces runoff even under relative low (1.5"/hr) potential runoff conditions. Under very low (<1"/hr) potential conditions, this potential contributing area reduced (58.5% for the Big Hill Creek Watershed). Runoff is chiefly generated as infiltration excess with rainfall intensities greater than soil permeabilities. As the watersheds' soil profiles become saturated, excess overland flow is produced. Generally,

storms producing less than 0.5"/hr of rain will generate runoff from only 7.3% for the Big Hill Creek Watershed, chiefly along the stream channels.

Background Levels: Five percent of the Verdigris River watershed is woodland. Leaf litter falls into the streams and decomposes increasing the oxygen demand. Background levels of ammonia should be small, in the vicinity of the average seen on the lower river of 0.10-0.14 mg/l.

Verdigris River Land Use

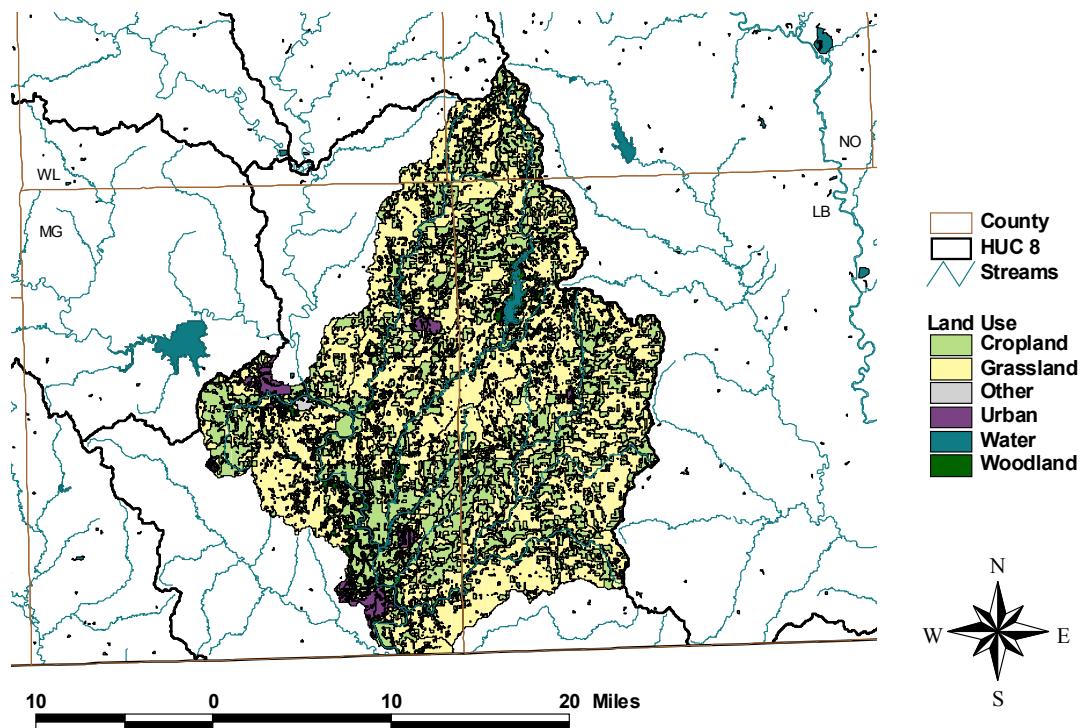


Figure 5

4. ALLOCATION OF POLLUTION REDUCTION RESPONSIBILITY

There is some relation between levels of ammonia loading and biological integrity. Decreased loads should result in improved aquatic communities, and biological metrics indicative of improved water quality. The biological and chemical data for this portion of the Verdigris River show some correlation between ammonia concentrations and MBI values. Meanwhile, it appears that the point sources potentially contributing impacts to the aquatic community of the river are now performing at a high level of treatment for ammonia.

While biological integrity is a function of multiple factors, the initial TMDL goal of this first phase will be to maintain ambient concentrations of ammonia at or below the average seen at flows below median flow and reduce the number of excursions of elevated ammonia under low flows exceeded 85% of the time. This goal will apply over the range of flows encountered on the Verdigris River, as indicated by the 0.14 mg/l average TMDL curves in Figure 2. There are two notable aspects of this TMDL: 1) there are no violations of the numeric ammonia criteria; and, 2) the curve fitted to the actual loads is below the target curve. Therefore, the impairments to the biological community by ammonia are not persistent and chronic, but rather independent incidents. This situation might be borne out further by the average MBI score lying below the 4.5 threshold, indicative of full support conditions. Additional analyses will be done during this phase of the TMDL to further investigate the impact of facility upgrade to the aquatic life of the river, as well as discern additional stressors in the river system which dampen those communities.

For this phase of the TMDL, an allocation of 591.6 pounds per day of ammonia will be maintained, on average. The calculations are presented in Appendix C. Seasonality in this TMDL is recognized by the seasonal varied ammonia permit limits present in the permits for Independence, Coffeyville, Cherryvale and Farmland. Future growth should continue to be accommodated by this TMDL, in that actual loads and wastewater volumes are below the levels identified by this TMDL.

Point Sources: There are six municipal facilities and one industrial facility discharging effluent into the watershed above the biological monitoring site. The assimilation of their existing ammonia loads into the ambient loads seen at the monitoring site is unknown, but the average seen in the stream is much less than what would be presumed by mass balance of the wasteloads from the seven facilities. One factor influencing this would be the higher permit limits allowed from November to February during periods when early stage life forms would be absent. These limits inflate the average ammonia level allowed to be discharged in wastewater, but during the biologically critical seasons, the ammonia limits are much reduced and the actual discharged levels are much less than those limits. Additionally, ammonia is not a conservative species, but undergoes transformations to other forms of nitrogen, ultimately resulting in nitrogen gas or organic nitrogen. At this stage of the TMDL, the assumed condition is maintenance of current average conditions during periods of full support at those low flows, presuming some of the offset of lower nonpoint source loading at higher flows.

The Wasteload Allocation represents the load to the stream which the point sources are currently permitted to contribute. With the recent upgrades in treatment facilities, in most cases, actual loadings are lower than these allocations except some times in winter, reflecting smaller than design service populations and satisfactory plant performance. For the three lagoon systems, an assumed value of 4 mg/l was applied based on results from the KDHE lagoon study. Once again, levels during the critical biological period are likely to be lower as are wastewater volumes. The following table outlines the average wasteload allocations assigned to the point sources. The average Wasteload Allocation sums to 526.8 pounds per day. This amount is applicable to flow conditions exceeded 85% of the time. The Wasteload Allocation will vary with season, reaching maximum during the winter and declining to a minimum in July and August.

Facility	Design Flow in cfs	Avg Permitted [NH3] in mg/l	NH3 Wasteload in lbs/day
Independence	4.64	6.25	155.9
Coffeyville	6.19	8.8	293.2
Cherryvale	0.62	6.28 (may drop to 4.0 with the construction of the lagoon system)	20.9
Farmland	4.12	2.4	53.4
Mound Valley	0.052	4.0	1.1
Edna	0.080	4.0	1.7
Liberty	0.028	4.0	0.6
Total	15.7	----	526.8

As previously noted in the source assessment, non-discharging lagoons of municipal facilities and agricultural livestock waste management systems do not discharge with sufficient frequency or duration to cause an impairment in the Verdigris River watershed. As such those facilities will have a Wasteload Allocation of zero under the flow conditions of concern in this TMDL. Typically, if these facilities discharge in the event of an intense rainfall occurrence, the corresponding streamflow from the watershed as a whole will be in the vicinity of the 1-5 percent exceedance and would transport any pollutant load swiftly out of the river system.

Nonpoint Sources: Generally, the 30Q10 of the Verdigris is around 30 cfs around Independence. The average ammonia concentration at Monitoring Station 105; the Verdigris River near Sycamore is around 0.4 mg/l. Therefore, the Load Allocation will be 64.8 pounds per day, reflecting the average upstream ammonia concentration and 30 cfs. This Load Allocation is applicable to flow conditions exceeded 85% of the time, coinciding with periods of observed biological impairment.

Defined Margin of Safety: The Margin of Safety is implied because of the conservative analysis made regarding ammonia. The population bases for the point sources are in decline, indicate adequate treatment capacity is available for the anticipated wasteloads. For example, Liberty rarely discharges from its facility. Actual performance of the treatment plants is better than permitted limits, except at times in winter. Cherryvale is on schedule to upgrade its treatment facility. In order to ensure that future pollutant loadings do not impair the biologic integrity of the stream, and given the variable nature of the MBI metric, the additional measure of 60% or more of individuals belonging to the EPT families, known for their pollution intolerance will be required to coincide with the anticipated increase in the number of MBI samplings which show full support of the aquatic population.

State Water Plan Implementation Priority: Because this watershed may be only sporadically impaired due to nonpoint pollutants, while improved wastewater quality has been made through treatment plant upgrades, as indicated by biological monitoring, this TMDL will be a Medium Priority for implementation, while additional stressor source assessment is done

Unified Watershed Assessment Priority Ranking: This watershed lies within the Middle Verdigris River Subbasin (HUC 8: 11070103) with a priority ranking of 26 (Medium Priority for restoration work).

Priority HUC 11s and Stream Segments: Because the impairment is in segments 27, 29, 33, and 35, the priority HUC 11s are 010 and 020.

5. IMPLEMENTATION

Desired Implementation Activities

1. Monitor wastewater discharges for excessive toxic ammonia loadings
2. Conduct field investigations at moderate to low flows to determine potential sources of stress to the aquatic community.

Implementation Programs Guidance

NPDES - KDHE

- a. Monitor effluent from wastewater systems to determine their ammonia contributions and ambient concentrations of receiving streams.
- b. Ensure proper monitoring, permitting, and operations of municipal wastewater systems to limit ammonia discharges.
- c. Oversee the timely completion of facility upgrade at Cherryvale.

Biological Monitoring - KDHE

- a. Investigate possible pollutants causing dampened productivity from the macro-invertebrate community.

Stream Channel Assessment and Restoration - SCC and KDHE

- a. Evaluate stream channel, beds, and banks for stability
- b. Prepare initial recommendations for any channel restoration activity.

Reservoir Management - KWO

- a. Coordinate with Division of Water Resources and Tulsa District, Army Corps of Engineers on low flow augmentation releases from Elk City Reservoir and protection of those releases from unauthorized diversion to support instream uses, including aquatic life.

Time Frame for Implementation: Evaluation of local water quality improvements in the watershed should occur prior to 2007 along with evaluation and upgrade of treatment performance of point source contributors. Investigation into other stress sources should be made by 2007, as well. Additional implementation of Best Management Practices will await the investigation into these other stressors.

Targeted Participants: Municipal point sources have initiated monitoring and appropriately treat effluent to reduce any excessive ammonia. In the future, some assessment of stormwater quality coming from urbanized areas of the watershed will be needed to ascertain the placement of impairing pollutants into the stream causing detectable impairment of the aquatic life community during low flows.

Additional participation will be deferred until additional source assessment is made.

Milestone for 2007: The year 2007 marks the midpoint of the ten-year implementation window for the watershed. At that point in time, adequate source assessment should be complete which allows further appropriate allocation of resources to responsible activities contributing to the biological impairment. Additionally, biological data from Verdigris River over 2002-2007 should not indicate trends of reduced support of the aquatic community. Average concentration of ammonia should be declining to levels commensurate with macroinvertebrate indices showing full support of the aquatic life function.

Delivery Agents: The primary delivery agents for program participation will be the Municipal and Industrial Programs of the Kansas Department of Health and Environment, working with point sources to continue to adequately management their waste water. Additionally, field crews from KDHE and the State Conservation Commission will be active in examining additional stress sources.

Reasonable Assurances:

Authorities: The following authorities may be used to direct activities in the watershed to reduce pollution.

1. K.S.A. 65-164 and 165 empowers the Secretary of KDHE to regulate the discharge of sewage into the waters of the state.

2. K.S.A. 65-171d empowers the Secretary of KDHE to prevent water pollution and to protect the beneficial uses of the waters of the state through required treatment of sewage and established water quality standards and to require permits by persons having a potential to discharge pollutants into the waters of the state.
3. K.A.R. 28-16-69 to -71 implements water quality protection by KDHE through the establishment and administration of critical water quality management areas on a watershed basis.
4. K.S.A. 82a-901, *et seq.* empowers the Kansas Water Office to develop a state water plan directing the protection and maintenance of surface water quality for the waters of the state.
5. K.S.A. 82a-951 creates the State Water Plan Fund to finance the implementation of the *Kansas Water Plan*.
6. The *Kansas Water Plan* and the Verdigris Basin Plan provide the guidance to state agencies to coordinate programs intent on protecting water quality and to target those programs to geographic areas of the state for high priority in implementation.

Funding: The State Water Plan Fund annually generates \$16-18 million and is the primary funding mechanism for implementing water quality protection and pollution reduction activities in the state through the Kansas Water Plan. The state water planning process, overseen by the Kansas Water Office, coordinates and directs programs and funding toward watersheds and water resources of highest priority. Typically, the state allocates at least 50% of the fund to programs supporting water quality protection. This watershed and its TMDL are a **Medium Priority** consideration. Priority should be given to activities which reduce loadings of sediment and organic material to the stream after 2007.

Effectiveness: Technology exists for adequate ammonia removal and can be placed in wastewater systems with proper planning and design.

Should non-point sources be identified as significant contributors to the biological impairment and there is lack of progress in improving water quality and biologic conditions from those seen over 1985-2001, the state may employ more stringent conditions on the watershed through establishment of a Critical Water Quality Management Area in order to meet the desired endpoints expressed in this TMDL.

6. MONITORING

At first, KDHE will continue to collect seasonal biological samples from Verdigris River for at least three years over 2002 - 2007 and an additional three years over 2007-2011 to evaluate continued reduction in ammonia levels and achievement of the desired biological endpoint. Monitoring of ammonia content of wastewater discharged from treatment systems will be continued under new and reissued NPDES and state permits.

Additional field monitoring will be made in-stream and along the channel to attempt to find additional causes of impairment to the biology of the stream. This information should be collected in 2002-2007 in order to support additional implementation projects.

7. FEEDBACK

Public Meetings: Public meetings to discuss TMDLs in the Verdigris Basin were held January 23 in Fredonia and March 6, 2002 in Neodesha. An active Internet Web site was established at <http://www.kdhe.state.ks.us/tmdl/> to convey information to the public on the general establishment of TMDLs and specific TMDLs for the Verdigris Basin.

Public Hearing: A Public Hearing on the TMDLs of the Verdigris Basin was held in Neodesha on June 4, 2002.

Basin Advisory Committee: The Verdigris Basin Advisory Committee met to discuss the TMDLs in the basin on October 3, 2001, January 23, March 6, and June 4, 2002.

Discussion with Interest Groups: Meetings to discuss TMDLs with interest groups include:
Kansas Farm Bureau: February 26 in Fredonia

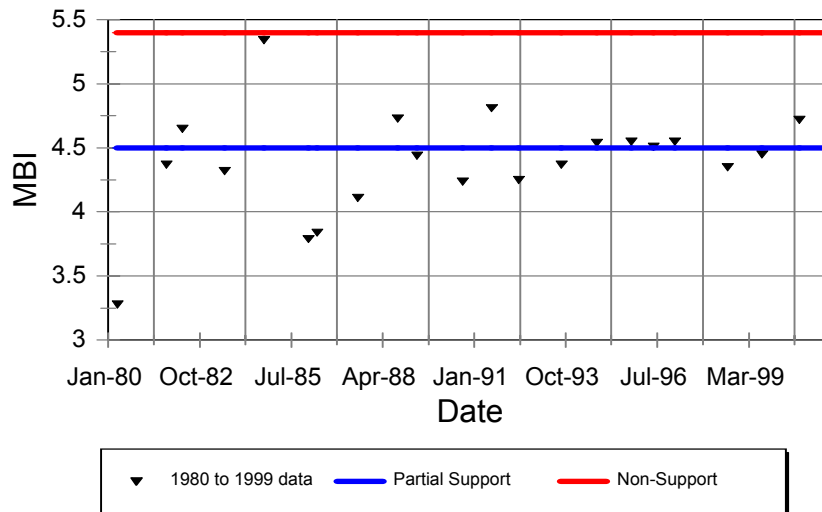
Milestone Evaluation: In 2007, evaluation will be made as to the amount of water quality improvement activity which has occurred within the watershed and current condition of the Verdigris River. Subsequent decisions will be made regarding the implementation approach and follow up of additional implementation in the watershed.

Consideration for 303(d) Delisting: The stream will be evaluated for delisting under Section 303(d), based on the monitoring data over the period 2007-2011. Therefore, the decision for delisting will come about in the preparation of the 2012 303(d) list. Should modifications be made to the applicable water quality criteria during the ten-year implementation period, consideration for delisting, desired endpoints of this TMDL and implementation activities may be adjusted accordingly.

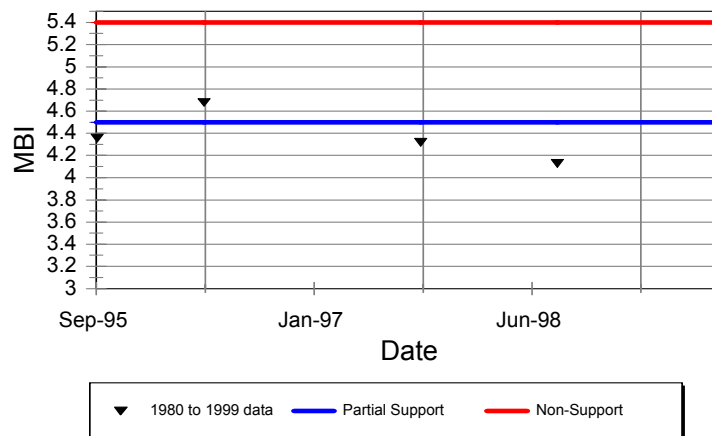
Incorporation into Continuing Planning Process, Water Quality Management Plan and the Kansas Water Planning Process: Under the current version of the Continuing Planning Process, the next anticipated revision will come in 2003 which will emphasize revision of the Water Quality Management Plan. At that time, incorporation of this TMDL will be made into both documents. Recommendations of this TMDL will be considered in *Kansas Water Plan* implementation decisions under the State Water Planning Process for Fiscal Years 2003-2007.

APPENDIX A

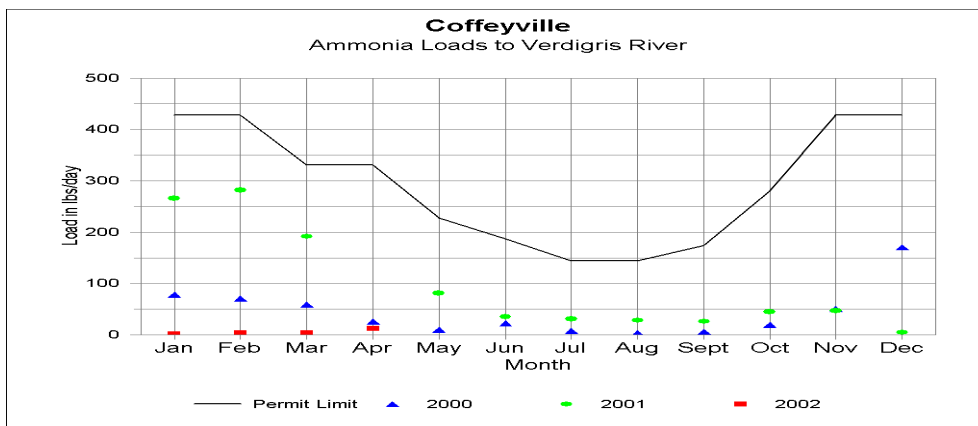
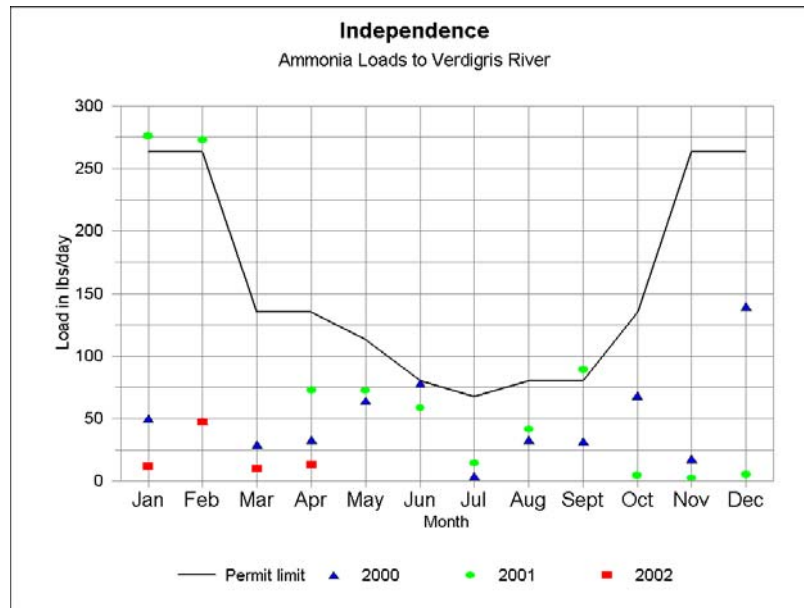
Verdigris River at Coffeyville (215) Nutrients/Biochemical Oxygen Demand

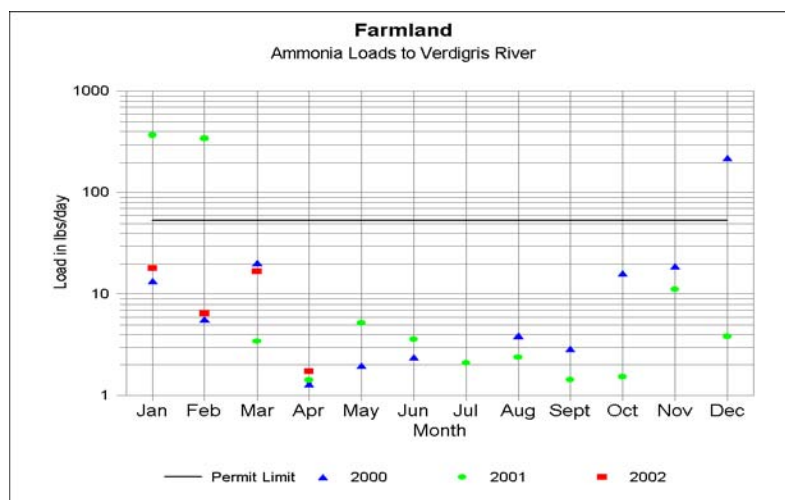
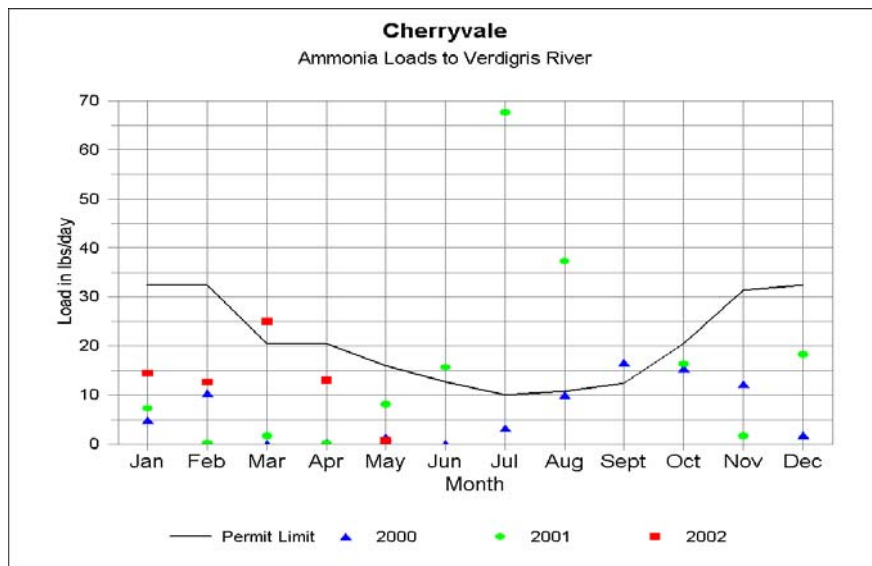


Verdigris River at Independence (563) Nutrients/Biochemical Oxygen Demand



APPENDIX B





APPENDIX C

Independence	3 MGD				TMDL	CALCS	avg conc	
	Flow (cfs)	NH3	NH3 load	Days/MO Monthly Load	indy	loadflow		
Jan	4.64	10.5	263	31 8155.728	coffey	293.2	6.19	8.8
Feb	4.64	10.5	263	28 7366.464	cherry	20.9	0.62	6.28
Mar	4.64	5.4	135	31 4194.3744	farmland	53.39	4.12	2.4
Apr	4.64	5.4	135	30 4059.072	mound	1.1	0.052	4
May	4.64	4.5	113	31 3495.312	val			
Jun	4.64	3.2	80	30 2405.376	edna	1.7	0.080	4
Jul	4.64	2.7	68	31 2097.1872	liberty	0.6	0.027	4
Aug	4.64	3.2	80	31 2485.5552	WLA	526.8	15.7	avg conc 6.21
Sept	4.64	3.2	80	30 2405.376				
Oct	4.64	5.4	135	31 4194.3744	LA	64.8		
Nov	4.64	10.5	263	30 7892.64	30 cfs			
Dec	4.64	10.5	263	31 8155.728	@0.4			
					mg/l			
	average	6.25		tot ann ld	56907			
				avg load	155.9			
Coffeyville	4 MGD				MOS			
	Flow (cfs)	NH3	NH3 load		implicit			
Jan	6.19	12.8	428	31 13263.4	TMDL	591.6		
Feb	6.19	12.8	428	28 11979.8	@46 cfs			
Mar	6.19	9.9	331	31 10258.4				
Apr	6.19	9.9	331	30 9927.5	avg conc	2.38		
May	6.19	6.8	227	31 7046.2				
Jun	6.19	5.6	187	30 5615.5				
Jul	6.19	4.3	144	31 4455.6				
Aug	6.19	4.3	144	31 4455.6				
Sept	6.19	5.2	174	30 5214.4				
Oct	6.19	8.4	281	31 8704.1				
Nov	6.19	12.8	428	30 12835.5				

Dec	6.19	12.8	428	31	13263.4
	average	8.8			
				tot ann	ld107020.
				avg load	293.2

Cherryvale 0.4 MGD

	Flow (cfs)	NH3	NH3 load		
Jan	0.62	9.7	32	31	1006.7436
Feb	0.62	9.7	32	28	909.3168
Mar	0.62	6.1	20	31	633.1068
Apr	0.62	6.1	20	30	612.684
May	0.62	4.8	16	31	498.1824
Jun	0.62	3.8	13	30	381.672
Jul	0.62	3	10	31	311.364
Aug	0.62	3.2	11	31	332.1216
Sept	0.62	3.7	12	30	371.628
Oct	0.62	6.1	20	31	633.1068
Nov	0.62	9.4	31	30	944.136
Dec	0.62	9.7	32	31	1006.7436
	average	6.275			
				tot ann	ld7640.8
				avg load	20.9

Farmland 2.66 MGD

	Flow (cfs)	NH3	NH3 load		
Jan	4.12	2.4	53	31	1655.2512
Feb	4.12	2.4	53	28	1495.0656
Mar	4.12	2.4	53	31	1655.2512
Apr	4.12	2.4	53	30	1601.856
May	4.12	2.4	53	31	1655.2512
Jun	4.12	2.4	53	30	1601.856
Jul	4.12	2.4	53	31	1655.2512
Aug	4.12	2.4	53	31	1655.2512
Sept	4.12	2.4	53	30	1601.856
Oct	4.12	2.4	53	31	1655.2512
Nov	4.12	2.4	53	30	1601.856
Dec	4.12	2.4	53	31	1655.2512
	average	2.4			
				tot ann	ld19489.
				avg load	53.39

Lagoon	Loadin	assumed		
	g			
	mgdfs	limit	load	
Mound V	0.0337	0.052	4	1.12
Edna	0.052	0.080	4	1.73
Liberty	0.018	0.0278	4	0.60